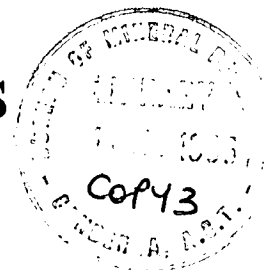


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COMMONWEALTH OF AUSTRALIA

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DEPARTMENT OF NATIONAL DEVELOPMENT  
BUREAU OF MINERAL RESOURCES  
GEOLOGY AND GEOPHYSICS



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RECORDS:

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1964/128

REPORT ON GEOCHEMICAL PROSPECTING PROGRAMME AT MOUNT ISA 1963.

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by

D.O. Zimmerman

The information contained in this report has been obtained by the Department of National Development, as part of the policy of the Commonwealth Government, to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

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REPORT ON GEOCHEMICAL PROSPECTING  
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SUMMARY

In 1963 the Bureau of Mineral Resources in cooperation with Mount Isa Mines Ltd commenced a programme of geochemical prospecting studies in the vicinity of mineralization at Mount Isa. In this report the geology and mineralization of the Mount Isa district is discussed, the aims of the geochemical investigation are set out, and geological factors relating to the geochemical study are considered. The areas sampled and the sampling methods employed at Mount Isa are described, the results of the orientation sampling and implications are given.

During the 1963 field season 2338 samples of soil, rock, diamond drill core and auger drill cuttings were collected from the vicinity of the Mount Isa lead-zinc and copper ore bodies. The results of the orientation sampling show that 36 elements are detectable by spectrographic analysis in samples of Urquhart Shale in the immediate vicinity of mineralization.

The results also showed that there is no significant enrichment in trace-element content for 20 ft below weathered bedrock surface. Consequently it is not necessary to sample deeper than four feet into weathered rock, i.e., sufficiently deep to avoid surface contamination. Analyses of the Mount Isa weathered rock (auger) and drill core samples has not yet begun but a suggested treatment of the results is outlined.

## INTRODUCTION

### Situation:

Mount Isa is situated in north-west Queensland, close to the Northern Territory border and approximately 230 air miles from the Gulf of Carpentaria. The town is serviced daily by rail and air services and it is situated on the main road linking Darwin and Alice Springs to the east coast of Australia.

The area is of low to moderate relief, approximately 1300 feet above sea level, and receives an average of about 12 inches of rainfall each year. Vegetation is stunted and consists mainly of spinifex grass, turpentine shrubs, and snappy gum and Gidyea trees. Soils are poorly developed and much of the surface cover consists of rubble and fine eluvial and alluvial outwash.

Mount Isa is situated in the valley of the Leichhardt River which is generally fairly flat (over shales and sheared basic lavas) with low hills rising where the rocks are more silicified than usual or where quartzites crop out.

### General Geology:

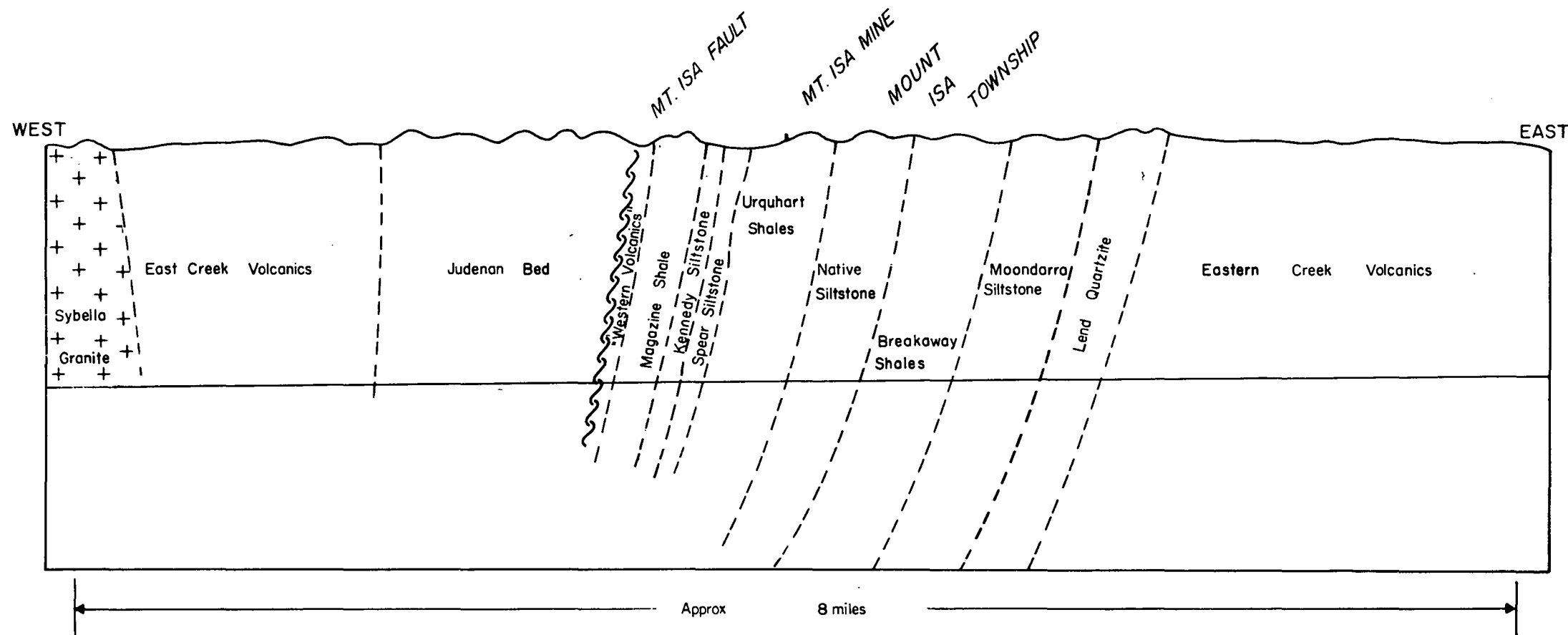
The general geology of the Mount Isa district has been described recently by Carter et al. (1961) and is illustrated on the Mount Isa and Cloncurry 1:250,000 Geological Sheets. Mount Isa is situated on the faulted east limb of a synclinoorium (see Fig. 1) and the principal lithologies are shale, siltstone, basic lavas (sheared) and quartzite. The economically important unit is the Mount Isa Shale, and more particularly its member the Urquhart Shale. The Mount Isa Shale consists of shales and siltstones which are dolomitic and/or carbonaceous in parts and which contain a few, very thin tuff beds. The Mount Isa Shale is underlain by the Eastern Creek Volcanics which consist essentially of sheared basic lavas, with a few interbedded lenses and beds of arenaceous sediments. Sheared basic lavas also crop out stratigraphically above, and in contact with, the Mount Isa Shale where it is bounded by the Mount Isa Fault. These basic lavas may represent unfaulted blocks of Eastern Creek Volcanics but they could represent a later period of vulcanicity. The Mount Isa Fault has uplifted the western limb of the Mount Isa Shale and this has since been removed by erosion. Rocks west of the Fault are the Judenan Beds (sericitic siltstone and quartzite) and Eastern Creek Volcanics which are intruded by the Sybella Granite. The grade of metamorphism west of the Fault is generally higher than in the Mount Isa Shale and the Mount Isa type mineralization is not thought to be connected with the rocks (including the granite) west of the Mount Isa Fault.

### Detailed Geology:

Mount Isa Mines (M.I.M.) geologists have subdivided the Mount Isa Shale as follows:

Top	Magazine Shale	- carbonaceous - forms prominent tree-covered ridges.
	Kennedy Siltstones	- sandy and dolomitic silts - grass covered

Fig 1.



DIAGRAMMATIC CROSS SECTION THROUGH MOUNT ISA  
Topography diagrammatic and not to scale

Spear Siltstones	- dolomitic siltstone - grass covered
Urquhart Shale	- thin bedded pyritic and/or dolomitic shales and siltstones including some potash-rich tuff beds.
Native Bee Siltstone	- partly dolomitic silts
Breakaway Shale	- essentially carbonaceous
Moondarra Siltstone	- dolomitic and non-dolomitic silts.

The detailed geology of the Mount Isa Shale is illustrated in Plate I. It consists essentially of north-south striking sediments, through which blocks of Eastern Creek Volcanics have been upfaulted. Mapping has not yet disclosed the Urquhart Shales south of the Crystallina Fault. Strike faulting is fairly common and such faults are commonly represented by prominent quartz veins or ridges of silicified and/or iron-rich rocks. These features are well represented in the Mount Novit area. Prominent ridges occur at Mount Isa and Northern Leases because of the presence of silica-rich gossans and, in the former locality, jasper breccias. The jasper breccias may represent the surface expression of the "silica-dolomite" bodies which contain the copper mineralization at Mount Isa.

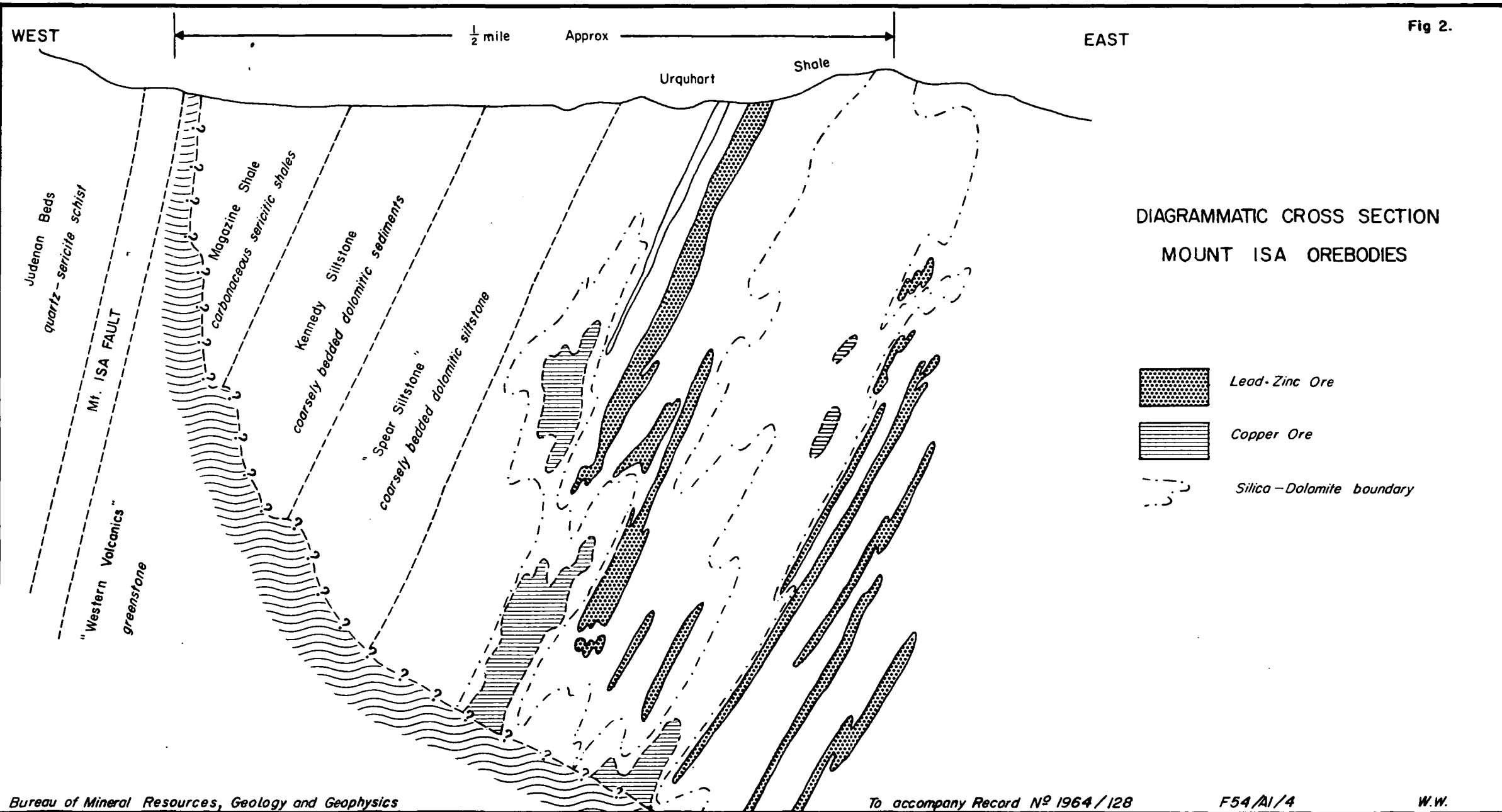
The subsurface geology at Mount Isa Mine is illustrated in Fig. 2. The most significant features are the irregularly shaped "silica-dolomite" bodies and the underlying greenstones (basic lavas - possible equivalent to, or a part of, the Eastern Creek Volcanics). "Silica-dolomite" bodies are deformed areas of a particular type which provide the host for copper mineralization at Mount Isa. The term is purely an exploration concept. There are four fundamental lithologies, which make up "silica-dolomite" bodies; these are fractured, silicified fine-grained shale, dolomitised shale (recrystallised dolomite along bedding planes), crystalline dolomite, and a type called "irreg." which is an irregular mixture of fractured silicified shale and dolomitised shale. Gradations between all four lithologies have been observed. The "silica-dolomite" bodies are generally slightly transgressive across the shales although conformable relationships are sometimes observed. In some localities coarsely crystalline dolomite is "intruded" between bedding planes of shales and it has forced the shales apart, in some instances for distances of more than 10 feet. Fragments of shale have been found in the intrusive coarsely crystalline dolomite. Recent work by M.I.M. geologists shows that "silica-dolomite" bodies generally become wider in depth and they commonly have a basal contact with greenstone.

#### Mineralization:

As mentioned above, copper mineralization is intimately associated with silica-dolomite bodies, which are known to outcrop only in a few places in the Mine area.

The silver-lead-zinc mineralization occurs in conformable bodies in the Urquhart Shale at Mount Isa (including the Bernborough and Leichhardt King prospects), Northern Leases, and at the Copalot Mine in the Mount Novit area. In the Mount Novit area the sediments are intensely sheared and it is difficult to see whether or not the

Fig 2.





mineralization is conformable. However in hand specimens it has a similar appearance to the conformable ores which occur further north. The mineralogy of the Mount Isa and Northern leases silver-lead-zinc deposits is relatively simple and consists essentially of pyrite, galena, and sphalerite, with small amounts of pyrrhotite, marcasite, chalcopyrite and arsenopyrite. Native silver is rare, as are sulpho salts of silver and antimony. Indium is present in the ore as a trace-element in greater than average amounts. The mineralogy of the copper orebodies is also simple. Chalcopyrite and pyrrhotite are the principal sulphide components.

There are several small copper prospects in the southern part of the area. These have only been examined at or near the surface in old workings and they appear to have two features in common. The prospects are all situated close to outcrops of Eastern Creek Volcanics and they are all localised in sheared siltstones and shales. The prospects include the Native Bee, Eagle's Nest, Cluny, Judy Lynn, Mid East, Copper Conquest, and an anonymous prospect near the Judy Lynn.

A lead prospect also occurs near the top of the Urquhart Shale west of the aerodrome. Little is known about this prospect and no geochemical work was carried out near it because of proximity to the aerodrome.

#### Theories of Ore Genesis and their Relation to the Geochemical Programme.

Until about ten years ago the Mount Isa deposits were regarded as hydrothermal-epigenetic, formed by selective replacement of favourable lithologies by hydrothermal solutions emanating from a deep-seated magmatic source (see Blanchard & Hall 1942). During the last decade the theory of contemporaneous deposition (so-called syngenetic) has gained favour and is now generally accepted for the lead-zinc mineralization (Fisher 1960). In the last three years evidence has been produced to suggest that the metals were derived from submarine volcanic emanations occurring at the same time as sedimentation (Stanton 1963). Sulphur isotope ratios also support a contemporaneous origin for the sulphides.

The origin of the copper orebodies is rather conjectural as they apparently have been subjected to a considerable amount of remobilisation. Current thinking among Mount Isa geologists is that the "silica dolomite" bodies represent structural modification of original sedimentary features, e.g., carbonate or reef facies, interfingering with the adjacent black shale facies. These theories do not explain why copper is restricted to the "silica dolomite" bodies and silver-lead-zinc is found outside the "silica dolomite" bodies. Mine geologists have observed that some lead-zinc orebodies occur between tongues of "silica dolomite" bodies and abut against them. No.7 orebody is an example. In this orebody the peak silver values occur within that part of the mineralization bounded by tongues of "silica dolomite"; the peak lead values occur between the extremities of the tongues of "silica dolomite" bodies; the peak zinc values occur some distance outside these extremities, and the peak iron values are furthest from the tongues of "silica dolomite". M.I.M. geologists are continually working on, and discussing these problems and new interpretations can be anticipated.

The close association of copper mineralization with sheared basic rocks in the Mount Isa area, and in fact in the whole Cloncurry-Mount Isa field, suggests that the copper ores may be derived by a process of "sweating-out" from the basic rocks.

If the sulphides at Mount Isa were deposited contemporaneously with the sediments, one might expect very little geochemical dispersion (primary dispersion) in the wall rocks of the orebodies. However there is abundant evidence that the sulphides at Mount Isa have been "remobilized" in some way; this evidence includes recrystallised sulphides, metamorphic ore textures, replacement textures, sulphide veining, and intrusive relationships of "silica dolomite" bodies containing chalcopyrite and pyrrhotite. It is to be hoped that, during the metamorphism of the sulphide-bearing rocks, some dispersion of trace elements will have occurred, probably by a process of solid diffusion. This could give rise to primary dispersion haloes around orebodies.

The greatest evidence of reconstitution occurs in the "silica dolomite" bodies. In these it is common to find increasing amounts of pyrrhotite as one approaches an ore zone; consequently trace-element haloes may also be expected. In contrast visible evidence of proximity to bedded lead-zinc mineralization is much less apparent, and trace-element haloes around these bodies may be much narrower and more subtle. However, as the lead-zinc orebodies are generally conformable, it is reasonable to expect that abnormal trace-element concentrations may occur in the mineralized stratigraphic horizons at some distance from the orebodies, and possibly beyond visible evidence of mineralization. This would tend to make trace-element haloes narrow, and a close sampling interval may be necessary to detect them in unweathered rocks.

In the near surface weathered rocks haloes around mineralization should be widespread because of the action of groundwater (secondary dispersion).

This discussion does not take into account the fact that many of the Mount Isa orebodies appear to be arranged en echelon along north-west south-east axes.

#### AIMS OF THE INVESTIGATION

The principal aim of the geochemical programme at Mount Isa is to determine whether or not significant trace element haloes exist around the copper, and silver-lead-zinc orebodies at, or near, Mount Isa. The search for geochemical haloes will be conducted in the near-surface oxidised rocks and in diamond drill cores in the primary zone in the ratio of 2:1.

Several subsidiary projects arise out of the investigation. Firstly the trace-element assemblages of the various stratigraphic units within the Mount Isa Shale will be studied to determine whether or not they show any diagnostic relationship to the mineralization. Secondly an attempt will be made to recognise the Urquhart Shale in the southern portion of the area on the basis of trace-element content. As yet surface mapping has failed to define this unit in the southern part of the area. Thirdly, the effect of cross-faulting on the trace-element content of the sediments will be studied.

In areas where mineralization is known, the analytical data will be examined for patterns which can be related to the mineralization. Elsewhere the results will be examined for patterns and these will be evaluated on the basis of known information and comparison with data over known mineralization.

### SAMPLING METHODS

#### Orientation Sampling

Twenty orientation samples were collected from six localities in the Urquhart Shale in the Mine area. At each locality it was possible to sample a particular bed, or group of thin beds, down dip for at least 12 feet below surface. At least two inches of rock were removed from the face of each exposure in order to avoid contamination before the samples were collected. The results of analyses of these samples showed that there was no marked enrichment or impoverishment in the overall trace-element content of the shales for 20 feet below bedrock surface. Consequently it was decided that auger sampling in the area could be carried out at less than five feet below bedrock surface. Surface contamination is also avoided by sampling within the weathered bedrock. Surface contamination is also avoided by sampling within the weathered bedrock. Sampling at more than 20 feet into bedrock was not considered because it would have greatly retarded the sampling rate and increased the overall costs of the programme.

#### Auger Sampling:

All surface sampling was carried out by means of a Gemco power auger. At each sampling point a hole was drilled through the alluvium and/or scree cover for about four feet below the weathered bedrock surface. The sample was collected from the lower foot of the auger rods and represents uncontaminated weathered rock. Most samples are taken from a depth of about 5 feet below surface although in some areas it was necessary to drill to about 15 feet. Some "soil" samples were collected at Northern Leases in addition to weathered rock samples for purposes of comparison. Orientation work indicated that samples from five feet below bedrock surface are equally as reliable as those from 20 feet below this surface. The figure of 4 feet below weathered rock surface was dictated largely by the length of the drilling rods, e.g., if one started drilling on bedrock it was possible to drill to 4 feet without adding another drilling rod, and this meant a considerable saving in time. Furthermore the figure of 4 feet below surface is considered ample to avoid surface contamination.

#### Diamond drill core sampling:

Drill core was made available by Mount Isa Mines in two forms, viz., solid core including sections which had been split for assay, and assay pulps from exploratory holes in which the whole core section had been split, crushed to minus 80 mesh, and quartered for assay. In the solid cores, samples were taken at intervals of from 10 to 50 feet, and the sampling interval was increased gradually within this range as the distance away from known mineralization increased. The solid cores were broken down using a hammer on a steel plate; fragments having freshly exposed surfaces were selected for the final sample. This should eliminate contamination on the outer surface of the cores caused by the drilling bit and by dust and oxidation. Assay pulp samples were bulked proportionally so that each geochemical sample represents 10 to 15 feet of drill core.

## SAMPLING PROGRAMME

### Detailed Samples:

(a) Northern Leases: Silver-lead-zinc mineralization is known to outcrop at Northern Leases, approximately 13 miles north of Mount Isa, within, and towards the top of, the Urquhart Shale. Accordingly a grid was laid out straddling the known mineralized portion of the Urquhart Shales. Traverses 1 and 7 were extended west to the outcrop of greenstone adjacent to the Mount Isa Fault, and east to the upper part of the Moondarra Siltstone. The grid pattern is shown in Plate 1; it consists essentially of twelve traverses at right angles to the strike, and spaced approximately 400 feet apart between Tombstone Hill and Handlebar Hill. The spacing of traverses is reduced to about 200 feet over the northern half of Handlebar Hill, along the traverses. Samples were collected at 50 feet intervals over the upper two thirds of the Urquhart Shale, and at 100 feet intervals outside this zone. The sampling intervals was reduced to 10 feet in a mineralized section of traverse 1. The spacing of traverses is somewhat irregular because of the need to avoid mine dumps, costeans and channels which had carried mine waters when development was in progress. Soil samples were also collected at Northern Leases from 6" below surface at some of the weathered rock sample localities. These are intended for comparison with results obtained by Debram (1953) during earlier work in the area.

(b) Mine Area: It was not possible to lay out a grid over known mineralization in the Mine area because of buildings, mine workings, mine waste fill, and the fact that much of the area is watered regularly with mine water which presumably is rich in trace elements. One traverse was sampled at 50 foot intervals across the strike approximately 300 feet south of the position of the south wall of the Black Rock Open Cut in August, 1963. This traverse commenced in barren shales, near the top of the Urquhart Shales, and ended against the steep ridge of jasper breccia and gossan outcrops which forms the eastern wall of the Black Rock Open Cut. The eastern portion of this traverse encountered copper mineralization although it is doubtful whether the traverse actually reached the footwall of the copper orebody. It is possible that samples on this traverse may have been contaminated in situ and this should be borne in mind when interpreting the results. The central portion of the traverse is particularly suspect because it represents an area which has been filled and levelled before buildings were erected. Despite the danger of contamination, this traverse was considered essential because it represents the only traverse over known near-surface copper mineralization at Mount Isa mine.

(c) Dawn Area: The Dawn area is situated in the lower section of the Urquhart Shales approximately one and a half miles SSE of the Black Rock Open Cut. An outcrop containing chrysocolla and tenorite was recently found in this area; moreover it is a relatively undisturbed area of known copper mineralization suitable for detailed geochemical study, and it is the nearest such area to Mount Isa Mine. The exposed copper mineralization occurs within a mile of known silica-dolomite type copper mineralization in the south end of the Mine area and it seems likely that the mineralization at the Dawn area is of the same type. Mount Isa Mines Ltd, are currently (October 1963) drilling a deep hole under the Dawn Area to supplement information already obtained from shallow churn-drill holes.

The sampling grid in the Dawn Area is based on mine grid making use of pegs put in for geophysical work in the area. The basic pattern consists of 10 east-west traverses 200 feet apart; the sampling interval on each traverse is 50 feet and the limits are fixed by a steep ridge on the western side and a railway line to the east. Traverses 21 and 22 were extended west to cross the upper half of the Urquhart Shales and the lower portion of the Spear Siltstone. Traverse 22 is programmed to be sampled west to the Mount Isa Fault. Thus traverses 21 and 22 will test the strike extension of the Bernborough Pb-Zn mineralization and the Cu-Pb-Zn mineralization in Mount Isa Mine in addition to the Dawn area. The most southerly traverse in the Dawn area, viz., the Gravity Traverse-Dawn Area, is also programmed to be sampled east to the Eastern Creek Volcanics and west to the Western Greenstone near the Mount Isa Fault.

#### General Sampling:

In addition to the detailed sampling, it is necessary to sample the whole section of the Mount Isa Shale from the Northern Leases south to the Mount Novit area. Thirty nine traverses have been marked across the valley from Eastern Creek Volcanics west to a fault boundary where the Mount Isa Shale is faulted against Judenan Beds or Eastern Creek Volcanics. A sampling interval of 100 feet has been recommended on these traverses.

North of Mount Isa the traverses are approximately 2500 feet apart, but there is a broad gap in the vicinity of the aerodrome. The irregular spacing and direction of the traverses results from a policy of keeping the traverses on fairly smooth terrain which can be readily serviced by the truck-mounted Gemco power auger. In addition most of these northern traverses have been stopped in the upper part of the Moondarra Siltstone because this unit crops out over a very broad area around Lake Moondarra. The unusually broad exposure of Moondarra Siltstone is due to gentle folding. Traverses were not extended across this area because they would have been parallel to the strike over much of their length, apart from gaps in the section across Lake Moondarra.

South of Mount Isa the traverse distribution is more irregular because of the topography and the more complex geology there. In addition traverse 36 and the Dawn Area Gravity Line had already been pegged at 100 foot intervals for a gravity survey.

#### Diamond Drill Holes:

Altogether 14 diamond drill holes were sampled; of these 10 were in core form and the remaining four had already been crushed and quartered for assay purposes. The details of the various holes are summarised in Table 1. The greatest proportion of the holes sampled intersect orebodies within the Mount Isa Mine. Emphasis has also been placed on the copper orebodies here, because of the lack of known near-surface copper bodies which could be tested by surface sampling. In addition, drill holes underlying surface sampling traverses at Northern Leases, Quartzite area, Biotite (Native Bee) area, and Copalot area have been sampled in order to allow correlation between samples from weathered and unweathered rocks.

TABLE 1

## SUMMARY OF DRILL HOLE SAMPLING - MOUNT ISA GEOCHEMICAL PROGRAMME

HOLE NO.	LOCATION	MINERALIZATION	FOOTAGE SAMPLED	TOTAL FOOTAGE	SAMPLE NO'	TOTAL NO. SAMPLES	REMARKS
14	Northern Leases	Ag. Pb. Zn. (Tr. Cu)	185-284 284-343 343-521 521-1360	1175	02-936-943 -1394-1399 -910-935 -1340-1393	94	drill core
21A 21 21A	Northern ) Leases )	Ag. Pb. Zn. (Tr. Cu)	830-880 893-1325 1312-2200	1470	02-1400-140 -944 - 99 -1405-1485	137	drill core
Quartzite No. 1	6m. N. of Mt Isa	Nil (Tr. Zn)	300-800 800-2612	2312	02-1576-1601 -1486-1575	116	drill core
W. 23C (No. 1?)	South end of Mine area	Cu (Tr. Pb)	130-2570	2440	02-1602-1775	174	drill core
Biotite No. 2	Native Bee area	Cu	235-2110	1875	02-2050-2164	115	drill core
Mount Novit No. 1	Copalot area	Nil	200-996	796	02-2004-2049	46	drill core
W. 26 W. Horiz.	U/G. Mine South end	Nil	0-945	945	02-995-1052	58	drill core
V. 26 E. Decl. No. 2	U/G. Mine South end	Cu	0-1600	1600	02-1053-1182	130	drill core- lower 700' greenstone samples 1142-1182
CV 38 E. Decl. No. 4	U/G. Mine	Cu (Tr. Pb)	610-1919	1309	02-1183-1297	115	assay pulps
R. 6 E. Decl. No. 1	U/G. Mine	Cu (Tr. Pb)	0-74.5 74.5-81.5 81.5-245 145-815 815-1445	1445	02-1919-1926 02-1298 1927-1943 1299-1339 2165-2212	115	assay pulps
H. 29 W. Horiz.	U/G. Mine	Pb	0-1080	1080	02-1776-1882	107	drill core
G. 27 W. Horiz.	U/G. Mine	Pb	0-350 350-980	980	02-1883-1918 1944-2003	96	drill core
N. 38 E. Decl. No. 1	U/G. Mine	Pb. Cu	0-804	804	02-2213-2280	68	assay pulp
N. 38 E. Decl. No. 2	U/G. Mine	Pb. Cu	0-748	748	02-2281-2338	58	assay pulp
14				18,979		1429	TOTAL

### Progress in Sampling:

On 7th November 1963, when I left Mount Isa, sampling of diamond drill cores, assay pulps, and detailed surface areas had been completed. A total of 2338 samples had been collected, comprising 909 rock and soil auger samples, and 1429 drill core and assay pulp samples. Traverses had been marked ready for the resumption of the surface sampling programme when the Gemco auger returned to Mount Isa in mid-November. Arrangements were made for Mount Isa Mines personnel to supervise the remaining surface sampling, and it was estimated that this would take about twelve weeks to complete. The remaining work involves about 13,000 feet of auger drilling and collection of about 1900 weathered rock samples.

It should be noted that some duplication of traverse numbers has occurred and numbers 16 and 22 apply to the Northern Leases and the Dawn area. These can be distinguished on the basis of sample numbers although confusion may arise over the western end of traverse 22, Dawn Area. This is marked on plans as "22 Dawn Area - West Extension".

### RESULTS OF ORIENTATION WORK

Twenty samples were collected from six localities in the vicinity of Mount Isa Mine in order to see what variation occurred in the trace element content of weathered shales from the surface to a depth of 20 feet. The samples were analyzed on a Hilger quartz prism optical emission spectrograph at Mount Isa by courtesy of Mount Isa Mines Ltd, (MIM), and the resulting plates were inspected by MIM's spectrographer to determine the elements present, and their concentrations relative to other samples from different depths at the same locality.

The following elements were detected, viz., Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, Ge, In, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Sc, Si, Sn, Sr, Ti, Tl, V, Yt, Zn, Zr. Moreover it was found that samples taken from within 5 feet of the weathered rock surface generally contain trace elements in quantities equal to, and in some instances, greater than those from deeper levels. This means that it is pointless to sample deeper than four to five feet into the weathered rock, unless of course one was prepared to sample very much deeper than 20 feet in order to obtain a sample more highly enriched in trace-elements.

All of the elements detected, excepting As, Cd, Sb, Si, and Yt, can be determined on the direct-reading spectrograph. Silica is presumably of no interest and can be excluded. However, it will probably be necessary to determine As, Cd, Sb, and Yt by some other method such as atomic absorption or X-ray fluorescence spectroscopy. Mercury is another trace element which should be investigated, and it can probably be checked on the Lemaire mercury detector.

In addition to the samples analysed in Mount Isa, 52 samples have been sent to the Australian Mineral Development Laboratories in Adelaide for complete semiquantitative analysis. This group of samples have been collected from three traverses in detailed areas, viz., the Black Rock Open Cut Traverse (sample numbers 02-592-608 inclusive), traverse 2 at Northern Leases (samples numbers 02-076, 78, 80 etc. to 112), and traverse 19 at the Dawn Area (sample numbers

02-709-725 inclusive). Each traverse in itself represents a section from barren rock into, or through, mineralization, and a thorough study of the results of these analyses may help greatly in planning the major analytical work in the Bureau laboratories.

#### ANALYTICAL METHODS

It is planned that the greater part of the samples collected at Mount Isa should be analysed on the direct-reading spectrograph currently being installed by the Bureau. However, as pointed out in the previous section, it will be necessary to use other analytical techniques to determine elements such as As, Cd, Sb, Yt, and Hg.

It may not be necessary to analyze all of the samples collected for all trace elements present. Patterns should become apparent after a small number of analyses, especially in the detailed areas. Once significant trace elements have been selected, the analytical work can probably be greatly streamlined.

#### SUGGESTED TREATMENT OF RESULTS

Halo Study: Analytical results should first be examined in separate groups, each group representing a field sampling traverse or a drill hole. Distinct rises or falls in element concentrations should be noted and related to known geology if possible. In particular the complimentary behaviour of groups of elements should be noted. In addition the inter-element ratios should be studied for at least one traverse in each detailed sampling area. The calculations involved can be programmed to a computer and set out as follows:



COMPUTER READ OUT PAPER

Ratios	Sample No.	Sample No.	Sample No.	Sample No.
	072	073	074	075
1= $\frac{Ag}{Al}$	"	"	"	"
2= $\frac{Ag}{As}$	"	"	"	"
3= $\frac{Ag}{B}$	"	"	"	"
4= $\frac{Ag}{Ba}$	"	"	"	"
5= $\frac{Ag}{Be}$	"	"	"	"
6= $\frac{Ag}{Bi}$	"	"	"	"
7= $\frac{Ag}{Ba}$	"	"	"	"
.				
.				
34= $\frac{Ag}{Zn}$	"	"	"	"
35 $\frac{Ag}{Zr}$	"	"	"	"
<hr/>				
35= $\frac{Al}{Ag}$				
36= $\frac{Al}{As}$				
.				
.				
69= $\frac{Al}{Zn}$				
70= $\frac{Al}{Zr}$				
<hr/>				
70= $\frac{As}{Ag}$				
71= $\frac{As}{Al}$				
72= $\frac{As}{B}$				
.				
.				
105= $\frac{As}{Zr}$				
<hr/>				
.				
.				
1190= $\frac{Zr}{Zn}$				
<hr/>				

i.e. there are 4190 possible ratios for each sample point; traverses in detailed areas average about 17 sample points making a total of 20,230 possible ratios per traverse.

After the ratios have been computed as above, the computer read-out sheets can be pinned to a large wall, side by side, in the relative position of the sample points in the field, viz.,

76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12																		
13																		
14																		
1190																		

TABLE2 Suggested layout of computer ratio-readout for visual inspection and comparison . w.w.

Each ratio can then be inspected and its significance decided. Particular attention should be given to significant patterns of element ratios in which the individual elements do not show distinct patterns when considered singly, e.g., the ratio( $B_i$ ) may prove to be significant, even though distinct patterns ( $I_n$ ) may not be apparent in the values for  $B_i$  or  $I_n$ .

It is suggested that ratios should first be studied on a traverse which shows distinct patterns in the absolute element values. The detailed traverses at the Northern Leases should be suitable for this purpose.

#### Stratigraphic Study:

The procedure described above can be applied to all stratigraphic traverses. Particular attention should be given to changes in trace element content near known mineralization and near the boundaries of each stratigraphic unit. In addition it will be necessary to calculate the mean trace element content for each stratigraphic unit. This can probably be done by first sorting the samples into the stratigraphic units to which they belong, and then processing all punch cards for a particular stratigraphic unit element by element to arrive at the mean concentration and standard deviation for each element.

Once characteristic trace element assemblages are fixed (presuming this will be possible) a search can be made through the results in the southern part of the area to determine whether the Urquhart Shales are present there.

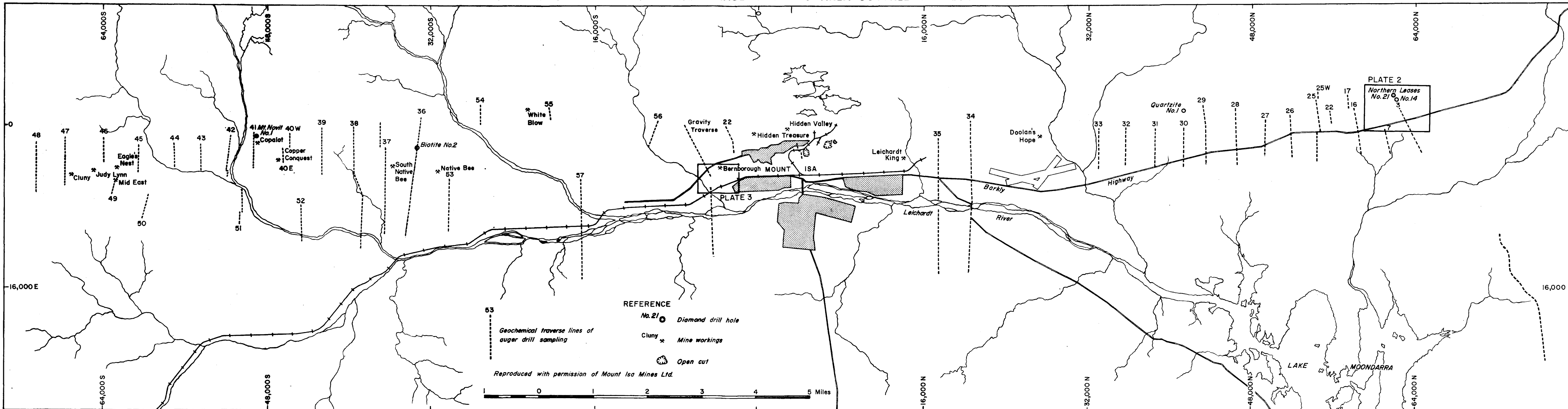
During initial examination of results along stratigraphic traverse, the possibility of trace element patterns related to faulting should be kept in mind. This applies particularly to traverses 28, the east end of Dawn Area Gravity Traverse (Lagoon Creek Fault), 56 (Crystallina Fault), 53 (east extension of Native Bee Fault), and 51, in addition changes in trace element content may occur as one approaches the numerous strike faults (transverse faults) in the area. These are particularly apparent south of Mount Isa where several blocks of Eastern Creek Volcanics have been upfaulted through the Mount Isa Shale succession.

#### Acknowledgements

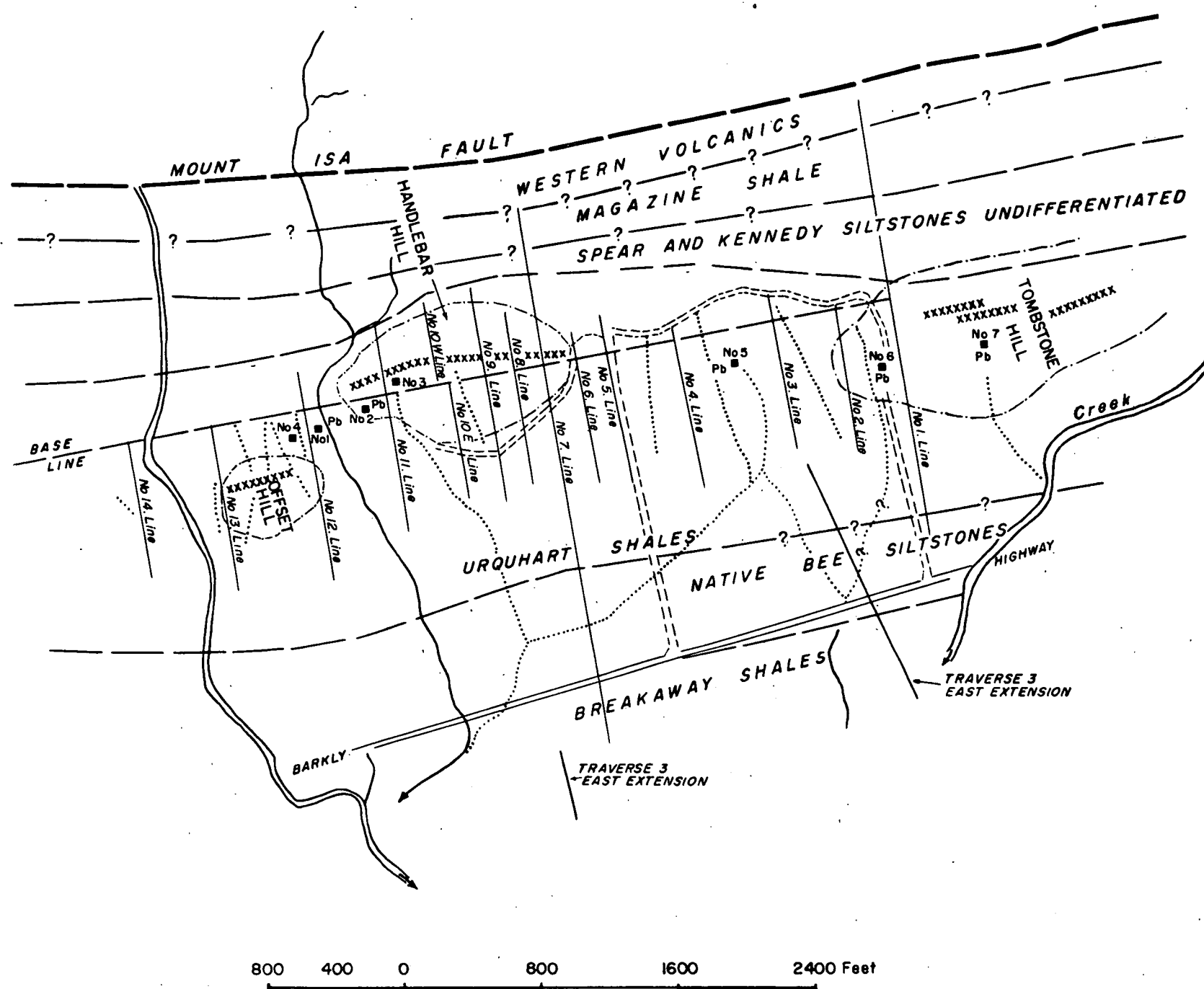
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# LOCALITY MAP OF MOUNT ISA MINES LEASE SHOWING AREA COVERED BY GEOCHEMICAL SAMPLING

PLATE 1



# MAP OF THE NORTHERN LEASES AREA, MT. ISA SHOWING GEOCHEMICAL GRID



## Reference

- No 3 Shaft
- Path of mine water discharge
- Pb Position of lead occurrences at surface
- Outcrop boundary
- xxxxxxxxxxxx Gossanous and silicified outcrops

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MAP OF DAWN AND BERNBOROUGH AREA, MT. ISA  
SHOWING GEOCHEMICAL GRID

Plate 3

